results in the loss of desirable tobacco flavorants thereby rendering this method undesirable for our purposes.

The use of microorganisms is known in the art of fermenting tobacco, especially tobaccos suitable for use in cigars and the like. Microorgnaisms have been used to produce milder tobaccos and to modify certain types of tobacco flavorants. More recently, US Patent 4,037,609 and DE-A-26 34 188 disclosed methods for reducing the nicotine content of tobacco by microbial treatment using microorganisms obtained from cigar tobacco. Aerobic fermentation techniques are employed wherein nicotine is degraded via microbial action to 3-succinoylpyridine. Although one of the organisms referred to (Cellulomonas sp.) is capable of reducing nitrate to nitrite, with some formation of nitrogen gas, it is not used for this purpose in the process described and it does not appear that such reduction occurs under the conditions employed. In FR-A-2 154 411 Erwinia sp. are employed to digest pectin bound plant material including tobacco. Once again, some of the organisms are capable of reducing nitrate to nitrite, but are not employed for that purpose. Moreover, residual nitrite in smoking materials can cause similar problems to nitrate.

Summary of the Invention

In accordance with the present invention, tobacco material extracts or effluents are subjected to microbial action of micro-organisms capable of reducing nitrate-nitrogen by dissimilatory denitrification to elementary nitrogen, which is removed as a gas, the process being carried out anaerobically on sterlized materials. Nitrate removal is accompanied by the concomitant reduction of the total nitrogen content of the treated materials. The process is specific for nitrate, leaving the cation concentration, i.e., K^+, Na^+, etc., unchanged. Nitrogen gas which is evolved can be reused for sparging gas, thus eliminating troublesome disposal problems experienced in prior methods of nitrate removal. The process does not require unduly expensive equipment and is not energy intensive. Moreover, the process is adaptable to all types of tobacco materials, such as leaf, stems, shredded filler, and aqueous tobacco extracts, whereas the known methods are generally applicable to tobacco that is ultimately utilized in reconstituted tobacco sheets. The dissimilatory reduction of nitrate-nitrogen gas follows a series of enzymatic reactions shown schematically below.

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CLAIMS

1. A process for the reduction of nitrate-nitrogen in tobacco materials, extracts or processing effluents in which the material, extract or effluent is sterilized and then subjected under substantially anaerobic conditions to the action of a microorganism capable of reducing nitrate-nitrogen by dissimilatory denitrification to form elemental nitrogen as the end-product, which is removed as a gas.

2. A process according to claim 1 in which the tobacco material, extract or effluent is maintained in contact with the microorganisms for a period of 12 to 72 hours, at a temperature of 20° to 40°C, a pH within the approximate range from 6 to 8, and a dissolved oxygen content of no more than 3 ppm.

3. A process according to claim 1 or 2, in which the tobacco material, extract or effluent is contacted with the inoculum to provide an initial concentration of at least 1×10^7 cells per ml.

4. A process according to claim 1, 2 or 3, in which tobacco material is extracted with water to produce an aqueous tobacco extract having a nitrate-nitrogen content of from 10 ppm to 3000 ppm, and the extract is then contacted with the microorganisms.

5. A process according to claim 1, 2 or 3 in which the tobacco material is suspended in water to form a slurry having a concentration of 5 to 40% solids by weight and the microorganisms are then added to the slurry.

6. A process according to claim 5, in which that slurry is formed having a concentration of 5-20% solids by weight.

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7. A process according to claim 1 or 2 in which an effluent stream having a nitrate-nitrogen content of at least 10 ppm is treated.

8. A process according to any one of claims 1 to 7 in which the denitrifying microorganism is Paracoccus denitrificans.

9. A process for the reduction of nitrate-nitrogen in tobacco materials, extracts or processing effluents substantially as described in any one of the Examples herein.

10. Tobacco materials or extracts treated by a process according to any one of claims 1 to 9.

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